

Nematode Parasites of Yellow Perch, *Perca flavescens*, from the Laurentian Great Lakes

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ABSTRACT: Yellow perch, *Perca flavescens* (Mitchill), from 4 localities in the Laurentian (North American) Great Lakes were examined for nematodes: from eastern Lake Michigan in 1990; from southern Lake Michigan in 1991; from The Black Hole, Saginaw Bay, Lake Huron in 1991; and from Oak Point, Saginaw Bay, Lake Huron in 1996. *Dichelyne cotylophora* (Ward and Magath) infected perch from each location and had the highest prevalence, mean intensity, and mean abundance at Oak Point. *Eustrongylides tubifex* (Nitzsch) Jägerskiöld was a common parasite of perch from Saginaw Bay, but it infrequently infected Lake Michigan perch. *Philometra cylindracea* (Ward and Magath) Van Cleave and Mueller was found in perch only from Saginaw Bay. *Contracaecum* sp. infrequently infected perch from Lake Michigan and The Black Hole. A comparative summary of the literature on nematodes infecting yellow perch from the Great Lakes is presented, listing 27 studies published since 1917. Four nematode genera utilize perch as intermediate hosts, and 5 genera utilize them as definitive hosts. Information on the life cycles and pathology caused by nematodes infecting yellow perch is presented.

KEY WORDS: Yellow perch, *Perca flavescens*, Percidae, Pisces, parasites, nematodes, Laurentian Great Lakes, Lake Michigan, Lake Huron, Saginaw Bay.

Several nematodes have been reported from yellow perch, *Perca flavescens* (Mitchill, 1814) (Percidae), in the Laurentian (North American) Great Lakes. In recent years, federal and state fisheries personnel, aquaculturists, and anglers have asked me to identify nematodes infecting yellow perch from the Great Lakes and to answer questions about them. Declines in the catch rates of perch have been reported in southern Lake Michigan; Saginaw Bay, Lake Huron; and western Lake Erie (Francis et al., 1996). The present study reports on the occurrence of *Dichelyne cotylophora* (Ward and Magath, 1917); *Eustrongylides tubifex* (Nitzsch, 1819) Jägerskiöld, 1909; *Philometra cylindracea* (Ward and Magath, 1917) Van Cleave and Mueller, 1934; and *Contracaecum* sp. in yellow perch from Lake Michigan and Saginaw Bay, Lake Huron. A summary of the nematodes infecting yellow perch from the Great Lakes is presented, with accompanying information on their life cycles and pathology. The possible relationship between the decline of yellow perch populations in some areas of the Great Lakes and the occurrence of parasitic nematodes is also discussed.

Materials and Methods

A total of 364 yellow perch was collected by beach seine and trawl from southern Lake Michigan (Michigan City, Indiana) in 1991; eastern Lake Michigan (Ludington, Michigan) in 1990; Saginaw Bay, Lake

Huron (The Black Hole) in 1991; and Saginaw Bay, Lake Huron (Oak Point) in 1996. Ludington is approximately 247 km north of Michigan City. Fish were sampled from the open water in Lake Michigan and also along the shore at Ludington. Saginaw Bay, a large shallow eutrophic bay divided into inner and outer areas, is the southwestern extension of Lake Huron located in east central Michigan. The inner area is shallower and warmer than the outer area, and is enriched with domestic, agricultural, and industrial inputs from the Saginaw River. The Black Hole in the Inner Saginaw Area and Oak Point in the Outer Saginaw Area are approximately 50 km apart.

Perch were put on ice in the field, frozen at the laboratory, and measured and sexed at necropsy when the abdominal cavity, viscera, muscle, gastrointestinal tract, and head were examined. *Dichelyne cotylophora*, *Eustrongylides tubifex*, and *Contracaecum* sp. were preserved in 70% alcohol and later cleared in glycerin for identification. *Philometra cylindracea* were broken during necropsy and pieces were placed in glycerin on a glass slide, allowed to clear, and examined with a light microscope; specimens were not kept. Prevalence is the percentage of fish infected in each sample, mean intensity is the mean number of nematodes of a species per infected fish, and mean abundance is the mean number of worms per examined fish. Voucher specimens have been deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland 20705: *Dichelyne cotylophora* (USNPC 88506) and *Eustrongylides tubifex* (USNPC 88507).

Results

Yellow perch from 2 locations in Lake Michigan and 2 locations in Saginaw Bay, Lake Huron, were examined for nematodes (Table 1).

Table 1. Number, collection time, and mean total length (mm) of *Perca flavescens* examined from Lake Michigan and Saginaw Bay, Lake Huron.

| Location | Month(s), year | Mean total length ± SD (range, 95% confidence interval) |
|--|--------------------|---|
| Michigan City, Indiana, southern Lake Michigan (100)* | August 1991 | 154 ± 67 (50–280, 141–168) |
| Ludington, Michigan, eastern Lake Michigan (64)* | May–September 1990 | 136 ± 23 (105–177, 131–142) |
| The Black Hole, inner Saginaw Bay, Lake Huron, Michigan (100)* | September 1991 | 172 ± 36 (110–278, 164–178) |
| Oak Point, outer Saginaw Bay, Lake Huron, Michigan (100)* | August 1996 | 202 ± 23 (170–287, 197–206) |

* (Number of yellow perch examined.)

There was a significant difference in the lengths of perch between locations (analysis of variance, $F = 35.9$, $P < 0.0001$) with those from Oak Point being larger. Forty-eight percent (48) of yellow perch from Michigan City in 1991, 26% (17) from Ludington in 1990, 96% (96) from The Black Hole in 1991, and 98% (98) from Oak Point in 1996 were infected with 1 or more nematodes.

Gravid *Dichelyne cotylophora* infected the intestines of yellow perch from each location (Table 2). It was significantly more prevalent in perch from Michigan City than from Ludington, Michigan (chi-square, $\chi^2 = 26.6$, $P < 0.005$); intensities were not significantly different, but abundances were (Mann–Whitney test, $U = 9,187$, $P < 0.0001$). In Saginaw Bay, prevalence (chi-square, $\chi^2 = 128.6$, $P < 0.005$) and abundance (Mann–Whitney test, $U = 6,064$, $P < 0.0001$) of *D. cotylophora* were significantly higher in perch from Oak Point than from The Black Hole. *Contracaecum* sp. infrequently occurred encysted on the surface of the heart, in the liver, and associated with the mesentery of perch from Lake Michigan and The Black Hole.

Eustrongylides tubifex was most common in perch from Saginaw Bay. The intensity (Mann–Whitney test, $U = 9,773$, $P < 0.0001$) and abundance (Mann–Whitney test, $U = 12,798$, $P < 0.0001$) of *E. tubifex* were significantly higher in perch from The Black Hole than from Oak Point. Larvae occurred in capsules associated with the mesentery on the surface of the ovaries, testes, liver, spleen, and gastrointestinal tract and free in the body cavity, viscera, and muscle. Of the 303 *E. tubifex* found in perch from Oak Point in 1996, 92% of the worms or capsules with worms were seen with the unaided eye, whereas 8% were detected only with a dissecting micro-

scope. Small and large *E. tubifex* were found in perch from both Saginaw Bay locations.

Philometra cylindracea, some of which were larvigerous, occurred free in the body cavity of perch only from Saginaw Bay, and was most common at Oak Point. Remains of crenulated and hardened masses of nematodes, probably dead *P. cylindracea* from past infections, were found in the body cavities and viscera of yellow perch from The Black Hole and Oak Point. All perch from Saginaw Bay in 1991 and 69% of them in 1996 that were infected with *P. cylindracea* were concurrently infected with *E. tubifex*. Ninety-six percent of Oak Point perch harbored at least 1 *E. tubifex* or *P. cylindracea* or remains of dead *P. cylindracea*.

There were no significant differences in the prevalence (chi-square analysis, $P > 0.05$) and intensity or abundance (Mann–Whitney test, $P > 0.05$) of *D. cotylophora*, *E. tubifex*, *P. cylindracea*, and *Contracaecum* sp. between female and male perch at any location. There were no significant correlations between the intensities of each nematode species and host length.

Discussion

At least 27 studies mentioning the nematode parasites of yellow perch from the Great Lakes have been published since 1917. The number of studies (in parentheses) performed in each Great Lake and associated connecting waters are: Lake Michigan (5), Lake Superior (1), St. Marys River (1), Lake Huron (7), Lake St. Clair (1), Lake Erie (12), and Lake Ontario (3) (Table 3). Many of these investigations did not report the number, length, and age of perch. Rosinski et al. (1997) reported that the nematode fauna of yellow perch in Saginaw Bay, Lake Huron, and Lake Huron proper are similar.

Table 2. Prevalence (P), mean intensity (MI), maximum number (MA) of nematodes infecting *Perca flavescens* from Lake Michigan and Saginaw Bay, Lake Huron.

| Nematode | LM, MC* (100) [†] | | | | LM, L* (64) [†] | | | | SB, BH* (100) [†] | | | | SB, OP* (100) [†] | | | |
|-------------------------------|----------------------------|------|------------|------|--------------------------|----|------|------------|----------------------------|-------|----|------|----------------------------|------|-------|--|
| | P | MI | SD (max.) | MA | SD | P | MI | SD (max.) | MA | SD | P | MI | SD (max.) | MA | SD | |
| <i>Contracaecum</i> sp. | 3 | 1 | | 0.03 | ± 0.2 | 8 | 2.00 | ± 1.2 (4) | 0.15 | ± 0.6 | 4 | 1 | | 0.04 | ± 0.2 | |
| <i>Dichelyne cotylophora</i> | 47 | 4.60 | ± 4.4 (19) | 2.15 | ± 3.8 | 19 | 4.20 | ± 4.7 (18) | 0.78 | ± 2.6 | 4 | 1.30 | ± 0.5 (2) | 0.05 | ± 0.3 | |
| <i>Eustrongylides tubifex</i> | 3 | 1 | | 0.03 | ± 17 | — | — | — | — | — | 95 | 9.10 | ± 7.4 (27) | 8.60 | ± 7.5 | |
| <i>Philometra cylindracea</i> | — | — | — | — | — | — | — | — | — | — | 10 | 1 | | 0.11 | ± 0.3 | |
| | | | | | | | | | | | 16 | 1.60 | ± 1.4 (6) | 0.26 | ± 0.8 | |

* LM, MC = Lake Michigan, Michigan City; LM, L = Lake Michigan, Ludington; SB, BH = Saginaw Bay, The Black Hole; SB, OP = Saginaw Bay, Oak Point.

† (Number of yellow perch examined.)

‡ Values calculated from 87 fish.

A total of 15 nematode taxa has been reported from yellow perch in the Great Lakes (Table 3). Of these, *Agamonema* sp., *Contracaecum* sp., *E. tubifex*, *Eustrongylides* sp., *Hysterothylacium brachyurum* (Ward and Magath, 1917) Van Cleave and Mueller, 1934, *Raphidascaris acus* (Bloch, 1779) Railliet and Henry, 1915, and *Raphidascaris* sp. are represented by larval or immature stages. Of the 10 nematodes identified to species, 6 mature in the intestine of perch. Prevalence data from the literature indicate that *D. cotylophora* is the most common nematode infecting perch from Lake Michigan, *R. acus* is most common in Lake Superior perch, and *D. cotylophora* and *E. tubifex* are most common in perch from Lakes Huron and Erie. The nematodes of perch from Lake Ontario have prevalences of 8% or less. The report of Bangham and Hunter (1939) of *Agamonema* sp. from perch in Lake Erie refers to an unidentified larval form, an immature nematode (J. Crites, pers. comm.), and will not be considered further.

In the present study, *Contracaecum* sp. is reported for the first time from perch in Lakes Michigan and Huron; all other nematodes found have been reported infecting perch from these lakes. Four nematode taxa were found in perch in the present study compared to the 15 nematode taxa reported in the literature. There are several possible reasons for this, including 1) I only examined perch from 2 Lake Michigan locations and Saginaw Bay, 2) more parasitological studies have been done on perch in Lakes Erie and Huron, and 3) it is difficult to determine if fish were collected from different habitats. It is pointless to discuss whether some nematodes of yellow perch have disappeared in the Great Lakes, because so few studies have been done in the past to which I can compare this study.

Dichelyne cotylophora infects yellow perch from all the Great Lakes and is commonly found in the anterior intestine. Visible lesions were not observed at the sites of adult attachment. I have found worms up to 8 mm in length. Based on experimental evidence, Baker (1984b) suggested that prey fish (cyprinid minnows) are intermediate hosts for *D. cotylophora*. This parasite is not host-specific to perch, since it has been reported from several fish species in Lake Michigan, St. Marys River, Lake Huron, Lake St. Clair, Lake Erie, and Lake Ontario (Ward and Magath, 1917; Pearse, 1924; Bangham, 1933, 1955; Bangham and Hunter, 1939; Muzzall,

Table 3. Reported nematodes of *Perca flavescens* from the Laurentian Great Lakes.

| Species | Lake* | Prevalence† | Locality | Reference |
|--------------------------------------|-------|--------------|--------------------|-----------------------------|
| <i>Agamonema</i> sp.‡ | E | 2 (2/128) | OH | Bangham and Hunter, 1939 |
| <i>Contracaecum</i> sp.‡ | M | 3 (3/100) | IN | Michigan City, this study |
| | | 8 (5/640) | MI | Ludington, this study |
| | H | 4 (4/100) | MI | The Black Hole, this study |
| <i>Camallanus oxycephalus</i> | H | —§ | MI | Rosinski et al., 1997 |
| | E | 2 (1/45) | OH, ONT | Bangham and Hunter, 1939 |
| | | 5 (5/93) | OH | Bangham, 1972 |
| | | —§ | OH | Stromberg and Crites, 1972 |
| | | 6 (45/735) | OH | Cooper et al., 1977 |
| | | 7 (27/408) | ONT | Dechtiar and Nepszy, 1988 |
| <i>Dichelyne cotylophora</i> | M | —§ | WI | Pearse, 1924 |
| | | 9 (1/11) | WI, IL | Amin, 1977 |
| | | 47 (47/100) | IN | Michigan City, this study |
| | | 19 (12/64) | MI | Ludington, this study |
| | | 42 (10/24) | ONT | Dechtiar and Lawrie, 1988 |
| | S | 33 (24/73) | MI | Muzzall, 1984 |
| | SMR | —§ | ONT | Smedley, 1934 |
| | | 55 (110/201) | ONT | Bangham, 1955 |
| | H | 2 (3/134) | ONT | Dechtiar et al., 1988 |
| | | —§ | MI | Rosinski et al., 1997 |
| | | 4 (4/100) | MI | The Black Hole, this study |
| | | 68 (68/100) | MI | Oak Point, this study |
| | | —§ | — | Ward and Magath, 1917 |
| | | —§ | ONT | Smedley, 1934 |
| | | 65 (45/69) | OH, ONT, NY, PA | Bangham and Hunter, 1939 |
| | | 10 (76/735) | OH | Cooper et al., 1977 |
| | | —§ | ONT | Baker, 1984a |
| | | 50 (6/12) | ONT | Baker, 1984b |
| | O | 6 (25/408) | ONT | Dechtiar and Nepszy, 1988 |
| | | —§ | ONT | Tedla and Fernando, 1969 |
| | | —§ | ONT | Tedla and Fernando, 1970 |
| | | 5 (7/150) | ONT | Dechtiar and Christie, 1988 |
| | | —§ | — | — |
| <i>Eustrongylides tubifex</i> ‡ | M | 2 (4/374) | MI | Allison, 1966 |
| | | 3 (3/100) | IN | Michigan City, this study |
| | H | 35 (293/831) | MI | Allison, 1966 |
| | | 2 (3/134) | ONT | Dechtiar et al., 1988 |
| | | 80 (193/240) | MI | Rosinski et al., 1997 |
| | | 95 (95/100) | MI | The Black Hole, this study |
| | | 74 (74/100) | MI | Oak Point, this study |
| | E | 38 (19/50) | OH | Measures, 1988b |
| | E | 41 (304/735) | OH | Cooper et al., 1977 |
| | | —§ | OH | Cooper et al., 1978 |
| | | —§ | OH | Crites, 1982 |
| | O | 50 (204/408) | ONT | Dechtiar and Nepszy, 1988 |
| | | 8 (5/150) | ONT | Dechtiar and Christie, 1988 |
| | | —§ | — | — |
| | | —§ | — | — |
| <i>Eustrongylides</i> sp.‡ | E | 8 (8/98) | OH | Bangham, 1972 |
| <i>Hysterothylacium brachyurum</i> † | S | 33 (8/24) | ONT | Dechtiar and Lawrie, 1988 |
| | E | 4 (16/408) | ONT | Dechtiar and Nepszy, 1988 |
| | O | 8 (5/150) | ONT | Dechtiar and Christie, 1988 |
| <i>Philometra cylindracea</i> | H | 1 (2/201) | ONT | Bangham, 1955 |
| | | 4 (5/134) | ONT | Dechtiar et al., 1988 |
| | | —§ | MI | Salz, 1989 |
| | | 24 (57/240) | MI | Rosinski et al., 1997 |
| | | 10 (10/100) | MI | The Black Hole, this study |
| | | 16 (16/100) | MI | Oak Point, this study |

Table 3. Continued.

| Species | Lake* | Prevalence† | Locality | Reference |
|---|-------|-------------|----------|-----------------------------|
| | E | 1 (1/128) | OH, ONT | Bangham and Hunter, 1939 |
| | | 8 (62/735) | OH | Cooper et al., 1977 |
| | | —§ | OH | Crites, 1982 |
| | | 10 (40/408) | ONT | Dechtiar and Nepszy, 1988 |
| | O | 5 (8/150) | ONT | Dechtiar and Christie, 1988 |
| <i>Raphidascaris acus</i> ‡ | S | 63 (15/24) | ONT | Dechtiar and Lawrie, 1988 |
| | H | 2 (3/134) | ONT | Dechtiar et al., 1988 |
| <i>Raphidascaris</i> sp.‡ | | —§ | MI | Rosinski et al., 1997 |
| <i>Rhabdochona canadensis</i> Moravec and Arai, 1971 | E | 8 (32/408) | ONT | Dechtiar and Nepszy, 1988 |
| <i>Rhabdochona ovifilamenta</i> Weller, 1938 | M | 1 (1/136) | MI | Weller, 1938 |
| | S | 8 (2/24) | ONT | Dechtiar and Lawrie, 1988 |
| <i>Spinitectus carolini</i> Holl, 1928 | E | 9 (6/69) | OH | Jilek and Crites, 1981 |
| | S | 8 (2/24) | ONT | Dechtiar and Lawrie, 1988 |
| <i>Spinitectus gracilis</i> Ward and Magath, 1917 | O | 1 (2/150) | ONT | Dechtiar and Christie, 1988 |
| <i>Spinitectus</i> sp. | E | 5 (5/98) | OH | Bangham, 1972 |

* E, Lake Erie; M, Lake Michigan; H, Lake Huron; S, Lake Superior; SMR, St. Marys River; LSC, Lake St. Clair; O, Lake Ontario.

† Percent infected (number of fish infected/number of fish examined).

‡ Larval stage.

§ Parasite present but prevalence not given.

|| Prevalence calculated from winter 1984 sample.

1984; Dechtiar and Christie, 1988). Cooper et al. (1977) demonstrated that the prevalence of *D. cotylophora* in perch in the western basin of Lake Erie decreased from 1927–1929, to 1957, to 1974.

Rhabdochona spp. and *Spinitectus* spp. infrequently occur in yellow perch from Lakes Michigan, Superior, and Erie, and Lakes Superior, Erie, and Ontario, respectively. Both genera are found in the intestine of several fish species and do little or no damage to their hosts. They utilize mayfly larvae and other arthropods as intermediate hosts.

Species not found as adults in the intestine of yellow perch are: *H. brachyurum*, *R. acus*, *Raphidascaris* sp., *Contracaecum* sp., *P. cylindracea*, *E. tubifex*, and *Eustrongylides* sp. Larval *H. brachyurum* have been reported in perch from 3 of the Great Lakes. Dechtiar and Lawrie (1988) found *H. brachyurum* and *R. acus* larvae in the liver of perch from Lake Superior and suggested that moderate to heavy liver damage occurred with fibrosis. Similarly, encysted *H. brachyurum* caused liver damage to perch in Lake Ontario (Dechtiar and Christie, 1988). Piscivorous fishes serve as definitive hosts for *H. brachyurum* and

Raphidascaris spp. *Contracaecum* spp. mature in piscivorous birds and mammals.

The redworm nematode complex of yellow perch in the Great Lakes is composed of *Camallanus oxycephalus*, *P. cylindracea*, and *E. tubifex*. The term “redworm” was coined by anglers asking the question, “What are these red worms in my fish?” (J. Crites, pers. comm.). *Camallanus oxycephalus* has been reported from yellow perch in 2 of the Great Lakes. Stromberg and Crites (1974) found that during July and August in Lake Erie, female *C. oxycephalus* protrude from the anus of white bass, *Morone chrysops*, and rupture, releasing infective larvae that are ingested by copepods. The life cycle is completed when infected copepods or small paratenic forage fish hosts are eaten by larger fish. Cooper et al. (1977) found that the prevalence of *C. oxycephalus* in yellow perch in western Lake Erie increased from 1927–1929, to 1957, to 1974.

In the present study, *P. cylindracea* only occurred in yellow perch from Saginaw Bay. Copepods are intermediate hosts for *P. cylindracea* (see Molnar and Fernando, 1975; Crites, 1982). It is not known if *P. cylindracea* utilizes a trans-

port host in its life cycle. *Philometra cylindracea* has been found in perch from 3 of the Great Lakes, occurring unencysted in the body cavity. This nematode matures in, and is host-specific to, yellow perch, since it has been reported from no other fish species. Mature females are about the same length as males (4 mm) or longer. Larvigerous females, which are delicate and have a thin transparent cuticle, may exceed 100 mm in length and are easily broken during host necropsy.

Eustrongylides tubifex had significantly higher prevalences, mean intensities, and mean abundances in yellow perch from Saginaw Bay than in those from Lake Michigan. Karmanova (1968) and Measures (1988a, b) reported that tubificid oligochaetes serve as intermediate hosts for *E. tubifex*. Although Brinkhurst (1967) and Schneider et al. (1969) found large numbers of tubificids in Saginaw Bay, Haas and Schaeffer (1992) did not find tubificids in perch stomachs in Saginaw Bay, and Rosinski et al. (1997) found them to be infrequent. The lack of tubificids in stomachs is surprising, since perch from Saginaw Bay and other areas of Lake Huron are heavily infected. Tubificids have been found in the stomachs of yellow perch from Lake Erie (J. Crites, pers. comm.), another lake where *E. tubifex* commonly occurs. The difference in infection values of *E. tubifex* between Saginaw Bay and Lake Michigan may be explained by the large number of tubificids in the bay and by the small numbers of them in Lake Michigan. Piscivorous birds (e.g., mergansers, *Mergus merganser* Linnaeus, 1758; see Measures, 1988c) serve as definitive hosts for *E. tubifex*, and differences in their numbers between these locations may also play a role in this difference.

Eustrongylides tubifex has been reported from yellow perch in 4 of the Great Lakes. It is infrequent in Lake Michigan, and the small number of perch examined from Lake Superior may not reflect its absence. Allison (1966) reported perch from the Detroit River infected with *E. tubifex*. Dechtiar and Christie (1988) found *E. tubifex* in several fish species from Lake Ontario and suggested that it caused damage to perch. This nematode is very common in yellow perch from Lake Erie. Interestingly, Bangham and Hunter (1939) did not report *E. tubifex* in an extensive survey of parasites of Lake Erie fishes, including 128 yellow perch. Bangham (1972) was the first to report the occurrence of *E. tu-*

bifex in yellow perch collected in 1957 from Lake Erie.

Eustrongylides tubifex is pink to red in color and thicker than *P. cylindracea*. Larval *E. tubifex* in fish intermediate hosts can reach 10 cm in length. Cooper et al. (1978) and Crites (1982) demonstrated experimentally that *E. tubifex* can be transferred when a small infected fish is eaten by a larger one. Crites (1982) reported that *E. tubifex* can live in capsules of host origin for at least 1.5 yr and demonstrated that the walls of the capsule have several different tissues and are furnished with capillaries. The larvae are nourished during their development and growth in these capsules. Measures (1988b) reported on the pathology of *E. tubifex* in fishes, including the yellow perch. It appears that *E. tubifex* infections in perch do not give rise to immunity, since larvae of different lengths were found in the same perch in the present study.

Crites (1982) showed that *E. tubifex* and *P. cylindracea* were associated with weight loss in yellow perch. It is not known if this weight loss affected fecundity. In addition, *P. cylindracea* sometimes infected the ovaries of perch, but whether this impairs reproductive capacity was not determined. Allison (1966) and Salz (1989) suggested these *E. tubifex* and *P. cylindracea* play a role in reduced perch growth and high mortality.

Excluding the Salmoniformes, percids are probably the most important group of fishes in the Great Lakes. Based on a review of the literature and the present study, it appears that nematodes do not greatly harm yellow perch, except for *E. tubifex* and *P. cylindracea*, which commonly infect perch in Saginaw Bay, other areas of Lake Huron, and Lake Erie (Allison, 1966; Crites, 1982; Salz, 1989; Rosinski et al., 1997). These are Great Lakes areas where the catch rates of perch have declined (Francis et al., 1996), but the direct effects of *E. tubifex* and *P. cylindracea* on reducing the numbers of perch in these areas are not known.

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NOTICE

EFFECTIVE WITH THE JANUARY, 2000 (VOL. 67, NO. 1) ISSUE, THE

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